WHAT IS CLAIMED IS:

1. An insulating film comprising:

a first barrier layer consisting of a material having a first bandgap and a first relative permittivity;

a well layer provided on the first barrier layer, consisting of a material having a second bandgap smaller than the first bandgap and having a second relative permittivity larger than first relative permittivity, discrete energy levels being formed in the well layer by a quantum effect; and

a second barrier layer provided on the well layer, consisting of a material having a third bandgap larger than the second bandgap and having a third relative permittivity smaller than second relative permittivity.

2. The insulating film according to claim 1, wherein

thicknesses of the first and second barrier layers are not smaller than 2.5 angstroms, and

the thickness d1 of the first barrier layer, the first relative permittivity ε1, the thickness d2 of the second barrier layer and the third permittivity ε2 satisfy the condition

$$2.5 > (d1/\varepsilon 1 + d2/\varepsilon 2).$$

3. The insulating film according to claim 2, wherein

the thicknesses of the first and second barrier layers are not smaller than 3.5 angstroms.

4. The insulating film according to claim 1, wherein

a thickness of the well layer is not larger than 5 angstroms.

5. The insulating film according to claim 1, wherein

energy levels of conduction bands of the first and second barrier layers are higher than an energy level of a conduction band of silicon by 1.0 electron volt or more, and

energy levels of valence bands of the first and second barrier layers are lower than an energy level of a valence band of silicon by 1.0 electron volt or more.

6. An insulating film comprising:

a first barrier layer consisting of a material having a conduction band whose energy level is higher than an energy level of a conduction band of silicon by 0.5 electron volts or more and having a valence band whose energy level is lower than an energy level of a valence band of silicon by 0.5 electron volts or more;

a well layer provided on the first barrier layer, the well layer consisting of a material having a bandgap smaller than a bandgap of SiO_2 and having a relative permittivity

larger than a relative permittivity of SiO_2, and a thickness of the well layer being not larger than 10 angstroms; and

a second barrier layer provided on the well layer, the second barrier layer consisting of a material having a conduction band whose energy level is higher than an energy level of a conduction band of silicon by 0.5 electron volts or more and having a valence band whose energy level is lower than an energy level of a valence band of silicon by 0.5 electron volts or more.

7. An insulating film comprising:

n (n being an integer larger than 2) layers of barrier layer consisting of a material having a bandgap larger than a first bandgap and having a relative permittivity smaller than a first relative permittivity; and

(n-1) layers of well layers consisting of a material having a bandgap smaller than the first bandgap and having a relative permittivity larger than the first relative permittivity, discrete energy levels being formed in the well layer by a quantum effect,

each of the barrier layers and each of the well layers being stacked by turns, and

discrete energy levels being formed in each of the well layers by a quantum effect.

8. The insulating film according to claim 7, wherein

thicknesses of the n layers of the barrier layers are not smaller than 2.5 angstroms, and

the thickness dm and the relative permittivity εm of the m-th barrier layer satisfy the condition

$2.5 > (d1/\varepsilon 1 + d2/\varepsilon 2 + \ldots + dn/\varepsilon n)$.

9. The insulating film according to claim 8, wherein

the thicknesses of the n layers of the barrier layers are not smaller than 3.5 angstroms.

10. The insulating film according to claim 7, wherein

a thickness of at least one of the well layers is not larger than 5 angstroms.

11. An insulating film comprising:

n (n being an integer larger than 2) layers of barrier layers consisting of a material having a conduction band whose energy level is higher than an energy level of a conduction band of silicon by 0.5 electron volts or more and having a valence band whose energy level is lower than an energy level of a valence band of silicon by 0.5 electron volts or more; and

(n-1) layers of well layers consisting of a material having a bandgap smaller than a bandgap of SiO_2 and having a relative permittivity larger than a relative permittivity of SiO_2, and thicknesses of the well layers being not larger than

10 angstroms,

each of the barrier layers and each of the well layers being stacked by turns to form a multi-quantum well structure.

12. An electronic device capable to operate as a capacitor, comprising:

a first electrode;

an insulating film provided on the first electrode, including:

n (n being an integer larger than 1) layers of barrier layer consisting of a material having a bandgap larger than a first bandgap and having a relative permittivity smaller than a first relative permittivity; and

(n-1) layers of well layers consisting of a material having a bandgap smaller than the first bandgap and having a relative permittivity larger than the first relative permittivity, discrete energy levels being formed in the well layer by a quantum effect,

each of the barrier layers and each of the well layers being stacked by turns, and

discrete energy levels being formed in each of the well layers by a quantum effect;

a second electrode provided on the insulating film.

13. An electronic device comprising:

a semiconductor layer;

an insulating film provided on the semiconductor layer, including:

n (n being an integer larger than 1) layers of barrier layer consisting of a material having a bandgap larger than a first bandgap and having a relative permittivity smaller than a first relative permittivity; and

(n-1) layers of well layers consisting of a material having a bandgap smaller than the first bandgap and having a relative permittivity larger than the first relative permittivity, discrete energy levels being formed in the well layer by a quantum effect,

each of the barrier layers and each of the well layers being stacked by turns, and

discrete energy levels being formed in each of the well layers by a quantum effect; and

a gate electrode provided on the insulating film,

an electric field in the semiconductor layer under the insulating film being controllable by applying a voltage to the gate electrode.

14. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having a perovskite structure,

a difference between $2^{1/2}$ times lattice constant of the perovskite structure along the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the perovskite structure being expressed by a chemical formula ABO_3,

the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%,

the element B including at least one selected from a group consisting of Ti, Zr and Hf, and

a percentage of Ti content in the element B being not larger than 50%.

15. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having a Ruddlesden-Popper type structure,

a difference between $2^{1/2}$ times lattice constant of the Ruddlesden-Popper type structure along the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the Ruddlesden-Popper type structure being expressed by a

chemical formula $A_{n+1}B_nO_{3n+1}$, the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%,

the element B including at least one selected from a group consisting of Ti, Zr and Hf,

a percentage of Ti content in the element B being not larger than 80% in a case where n=1,

a percentage of Ti content in the element B being not larger than 70% in a case where n=2,

a percentage of Ti content in the element B being not larger than 60% in a case where n=3, and

a percentage of Ti content in the element B being not larger than 50% in a case where n≥4.

16. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having a Ruddlesden-Popper type structure,

a difference between $2^{1/2}$ times lattice constant of the Ruddlesden-Popper type structure along the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the Ruddlesden-Popper type structure having a structure

where a layer expressed by a chemical formula A2BO4 and a layer expressed by a chemical formula $A_3B_2O_7$ are stacked by turns,

the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%, and

the element B including at least one selected from a group consisting of Ti, Zr and Hf.

17. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having an in-phase type structure,

a difference between $2^{1/2}$ times lattice constant of the in-phase type structure along the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the in-phase type structure being expressed by a chemical formula $A_{n+2}B_nO_{3n+2}$,

the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%, and

the element B including at least one selected from a group consisting of Ti, Zr and Hf.

18. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having an in-phase type structure,

a difference between $2^{1/2}$ times lattice constant of the in-phase type structure along the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the in-phase type structure having a structure where a layer expressed by a chemical formula A_3BO_5 and a layer expressed by a chemical formula $A_4B_2O_8$ are stacked by turns,

the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%, and

the element B including at least one selected from a group consisting of Ti, Zr and Hf.

19. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having a well layer,

a difference between $2^{1/2}$ times lattice constant of the dielectric film the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the well layer being expressed by a chemical formula mAO + $nABO_3$ (m being integer larger than 2, and n being integer larger than zero) where a layer of a sodium chloride structure expressed by a chemical formula AO and a layer of a perovskite structure expressed by a chemical formula ABO_3 are stacked,

the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%, and

the element B including at least one selected from a group consisting of Ti, Zr and Hf.

20. An electronic device comprising:

a semiconductor layer containing silicon as a major component; and

a dielectric film epitaxially grown directly on a major surface of the semiconductor layer, the dielectric film having a well layer,

a difference between $2^{1/2}$ times lattice constant of the

dielectric film the major plane and a lattice constant of the semiconductor layer along the major plane being not larger than 1.5 %,

the well layer having a structure where a layer expressed by a chemical formula $mAO + ABO_3$ (m being integer larger than zero) and a layer expressed by a chemical formula $nAO + 2ABO_3$ (n being integer larger than zero) are stacked by turns, including a layer of a sodium chloride structure expressed by a chemical formula AO and a layer of a perovskite structure expressed by a chemical formula ABO_3,

the element A including at least one selected from a group consisting of Ba, Sr, Ca and Mg,

a percentage of Mg content in the element A being not larger than 10%, and

the element B including at least one selected from a group consisting of Ti, Zr and Hf.